LAND SEA AIR SPACE

AEROSPACE RECOMMENDED PRACTICE

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SURFACE PREPARATION AND PRIMING OF ALUMINUM ALLOY PARTS FOR HIGH DURABILITY STRUCTURAL ADHESIVE BONDING
Hand Applied Phosphoric Acid Anodizing

1. SCOPE

1.1 This document describes a hand-applied, non-tank, phosphoric acid anodizing process for surface preparation of aluminum alloys for structural adhesive bonding to achieve optimum bondline durability.

1.2 This surface preparation system is designed to be used where a metal bond repair is required on a component and the component or assembly cannot be immersed in a tank.

1.3 This surface preparation system has been validated for use with 180° F (82° C) service, elastomer-modified, epoxy adhesive and corrosion-inhibiting primer.

1.4 The process described herein is the result of extensive evaluation of structural and durability performance investigation and detailed analysis of the individual bonding surfaces.

2. DESCRIPTION OF THE PROCESS

2.1 The surface preparation is the most critical step in the adhesive bonding process. The method and adequacy of the preparation of the adherend surfaces will determine the success or failure of the bond. In many cases, it will be necessary to use a non-tank or hand procedure for repair on components that cannot be immersed in a tank or where surface preparation tanks are not available.

2.2 This document outlines the recommended procedures from hand solvent cleaning, surface abrasion, and non-tank phosphoric acid anodizing through application and cure of the corrosion-inhibiting adhesive primer. Application of the applicable adhesive and mating the component parts becomes involved in individual part geometry and complexity, and must be covered in a procedure prepared for each specific assembly or part.

2.3 To achieve the high reliability and durability required, special processing techniques must be followed as outlined in the primary steps shown below:

Solvent wipe
Abrade
Apply gelled phosphoric acid, gauze, and screen
Anodize
Remove screen and gauze
Rinse
Dry
Check for color
Apply primer
Dry or cure primer
Apply adhesive
Assemble component parts
Cure structural assembly

3. HANDLING OF PARTS

3.1 If the anodized surface becomes contaminated, or has areas which indicate no anodic film, corrective action should be accomplished by reprocessing, beginning with abrading.

3.2 Parts or surface areas of assemblies after anodizing, priming, and curing should be adhesive bonded within 8 hr of primer cure (See 6.5.3), however parts may be stored in a protected noncontaminated atmosphere for up to 96 hours.

CAUTION Do not touch the dried anodized surface. Do not apply tape to the surface.

4. REPAIR ATMOSPHERIC ENVIRONMENT

4.1 The work area where surface cleaning of parts is performed should be isolated from operations that generate dust, oil vapors, or other contaminants. Similarly, smoking or eating in the controlled area should be prohibited.

4.2 All personnel handling cleaned parts should wear clean, white, lint-free gloves. The area to be bonded should not be touched during handling by hands, gloves, or protective covering.

4.3 Immediately after cleaning, parts should be moved into a controlled atmosphere area for bond assembly.

4.4 If the cleaning and controlled bonding area are not in proximity, the parts, after cleaning, should be sealed in noncontaminating wrapping for transfer to controlled atmosphere layout area.

4.5 Where practical, it is recommended that parts be removed from the aircraft for repair in the shop.

4.6 In cases where it becomes necessary to make repairs on the aircraft, special care should be taken to prevent the cleaning solutions from contacting surrounding surfaces, especially the surfaces of high-strength steels and honeycomb core, or from entering crevices.

4.7 Bonding of the part should be completed as soon as possible after cleaning, to minimize subsequent contamination.

5. SAFETY PRECAUTIONS

5.1 The following safety precautions should be strictly observed while making repairs or removing moisture:

5.1.1 If the repair is to be made while the component is on the aircraft, the aircraft and repair cart, if used, should be statically grounded. Only approved explosionproof electrical equipment should be used. Electrical equipment should be grounded while in operation.

5.1.2 The fuel tank of the aircraft should be purged and checked continuously to prevent formation of a potentially explosive mixture. The repair area should be kept well ventilated. Fire-fighting equipment should be available during the repair operation.

5.1.3 Always add acid to water; never add water to acid. The solution should not come in contact with skin or clothing. In case of contact, immediately wash the affected area with generous amounts of cold water. Always wear eye protection and rubber gloves when using these solutions.

6. SURFACE PREPARATION PROCEDURE

6.1 All fabrication processes, inspections, prefits, and adjustments for individually identified assemblies should be completed before the start of the surface preparation cycle.

6.2 The preparation procedure shown in synopsis in 2.3 should be performed in a continuous operation as detailed in the following paragraphs:

NOTE: Prior to the start of processing, be sure undamaged areas, crevices, and fasteners are protected from acid contamination by masking off these areas with suitable tape and plastic film. Protect working bench tops and surrounding areas by placing plastic film (e.g., mylar) between the part and the bench top.

6.2.1 Precleaning:

6.2.1.1 Solvent wipe the surfaces surrounding the repair area to remove soil, such as oil, dirt, and grease.

6.2.1.2 Remove organic finish from affected surfaces with solvents, mechanical abrasion, or approved stripper. Prevent strippers from entering existing bondlines, as strippers may have deleterious effects on the bond. If tightly adherent old adhesive is exposed on an inner surface, it could remain; smooth over to remove rough spots (do not expose bare metal) and use as a base for new adhesive bond.

6.2.2 Phosphoric Acid Non-tank Application:

6.2.2.1 Solvent wipe the surfaces to be anodized using methyl ethyl ketone (MEK), 1,1,1 trichloroethane (MIL-T-81533), or equivalent.

6.2.2.2 Abrade the surface with nonwoven abrasive, such as nylon abrasive pads or equivalent.

6.2.2.3 Dry wipe with clean gauze to remove dust and debris.

6.2.2.4 Apply a uniform coat of gelled phosphoric acid (See 8.1), 12% by wt, to the aluminum surface, using a glue brush.

NOTE: The gelled phosphoric acid compound can be made by thickening a 10% to 12% by weight solution of phosphoric acid by adding inorganic filler material to form a paste (e.g., add 1/2 gal (2 L) of inorganic filler powder to 200 mL of acid solution) (See 8.1 and 8.2).

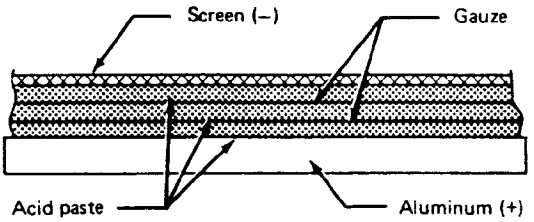
6.2.2.5 Place 2 or 3 layers of gauze or cheesecloth over the top of the gelled acid coating; apply another coat of gelled phosphoric acid to completely saturate the gauze.

6.2.2.6 Place a piece of stainless steel screen over the phosphoric acid gel and gauze layer. The gauze and screen should be approximately the same size as the area to be anodized.

6.2.2.7 Apply another coating of the gelled phosphoric acid over the stainless steel screen.

CAUTION: Be sure the stainless screen does not contact any part of the aluminum surface being anodized.

6.2.2.8 Connect the screen as the cathode (-) and the aluminum to be anodized as the anode (+). (See Fig. 1)



ANODIZING IN PROCESS

FIGURE 1

6.2.2.9 Apply a DC potential of 4 to 6 volts for 10 to 12 minutes.

NOTE: A rectifier may be used to supply the voltage and current during anodizing. Current density should be in the range of 1 - 7 amp per sq ft (10.8 - 75 A/m^2). When other power source is not available, a fresh or fully charged dry or wet cell battery may be used to anodize small areas.

6.2.2.10 At the end of the anodizing time, open the circuit, remove the screen and gauze.

6.2.2.11 Moisten a piece of clean gauze with distilled water and lightly wipe off the gelled acid with the moistened gauze as quickly as possible. Do not rub the anodized surface. Immersion or spray rinse should be used if possible.

6.2.2.12 Air dry for not less than 30 min. at room temperature or force-air oven dry at 140° to 160°F (60° to 70°C). A hot air gun may be useful in drying, provided the temperature does not exceed 160° F (70°C).

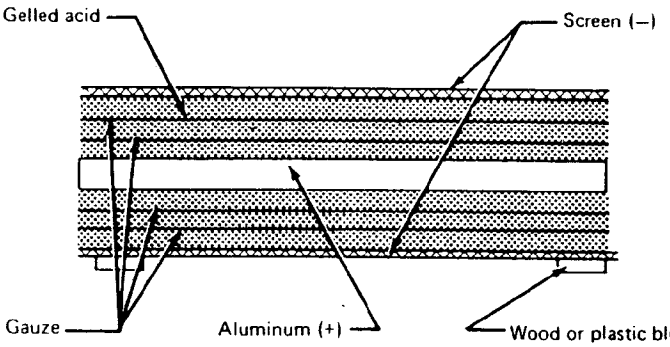
6.2.2.13 Examine the treated surface for uniformity of coating. A properly anodized surface will show an interference color (original color changes to a complementary color) when viewed through a polarizing filter rotating 90 deg and examined at a low angle of incidence to flurescent light or daylight.

6.2.2.14 If no color is observed, repeat steps 6.2.2.2 through 6.2.2.13.

NOTE: Machined surfaces or abraded surfaces sometimes are difficult to inspect for color. Rotation of the polarizing filter is required because some pale shades of yellow or green are so close to white that without a color-change inspection, they might be considered "no color", which would falsely indicate no anodic coating.

6.3 Anodizing Both Sides Simultaneously:

6.3.1 In the case of patch doublers or skin details in which both surfaces are to be anodized, a setup as shown in Fig. 2 may be used.



SET UP FOR ANODIZING BOTH SIDES OF ALUMINUM DETAIL

FIGURE 2

6.3.2 In this procedure, both surfaces of the aluminum are coated with the gelled phosphoric acid, covered with acid-coated gauze (2 layers) and then covered with the stainless steel screen as the cathode.

6.3.3 Elevate the part slightly to allow gases formed during anodizing to escape from the bottom surface. Trapped gases will result in smut deposits on the surface and poor surface preparation.

6.4 Anodizing of Inverted (Overhead) Surfaces: This type of surface is very difficult to repair as gravity is a problem. A plastic container should be placed under the area to catch the liquid that will be lost during processing. Overhead surfaces exceeding 4 sq. in. (26 cm^2) should not be anodized in that position; if possible, invert the component to allow working on a flat surface.

6.4.1 Prepare the overhead surface as described in 6.2.2.1 through 6.2.2.3.

6.4.2 On a bench top, or equivalent, secure a piece of stainless steel screen to the surface of a clear acrylic sheet, approximately 0.06 in. (1.5 mm) thick, using vinyl type electroplaters tape. The screen should be slightly larger than the area to be anodized and the acrylic sheet should be slightly larger than the screen.

6.4.3 Attach a stainless steel wire to the screen to be connected as the cathode (–).

6.4.4 Apply a uniform coat of the gelled phosphoric acid to the screen.

6.4.5 Place 2 or 3 layers of gauze over the gelled acid coated screen; apply another coat of the gelled acid to completely saturate the gauze.

6.4.6 Wet the surface to be anodized with the gelled acid and immediately secure the screen and gauze to the area by taping to the surface using the acrylic sheet to hold the gauze and screen securely on the surface.

CAUTION: Be sure the stainless steel screen does not contact any part of the aluminum surface being anodized and that no voids occur between the gauze, the screen, and the surface being anodized.

6.4.7 Connect the screen as the cathode (–) and the aluminum surface as the anode (+) and anodize as described in 6.2.2.9 through 6.2.2.14.